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Satellite and Modelling based Investigations of the Middle Atmospheric Temperature Climatology over the Equatorial Regions

Som Sharma* [(1)], Neesha Patel[(2)], Narendra Ojha [(1)], Vaidehi Joshi[(1)] and Sourita Saha[(1)],
(1) Physical Research Laboratory, Ahmedabad, India, 380009, e-mail: somkumar@prl.res.in; ojha@prl.res.in; joshivaidehi7890@gmail.com; sourita@prl.res.in
(2) Kadi Sarva Vishwavidyalaya, Ghandhinagar, India, e-mail: neeshapatel09@gmail.com

Equatorial atmospheric regions are unique and one of the most important parts of the Erath's atmosphere. These regions receive maximum energy from the Sun and are highly turbulent. Height of the tropopause is maximum over the equatorial regions and several complex processes are taking place all the times. Further, they are always influenced by the processes of Northern Hemisphere as well as by the Southern Hemisphere. Atmospheric temperature is one the most sensitive parameters and having imprints of dynamical, radiative and chemical processes. Thermal structure, seasonal variability and atmospheric oscillations occurring in the equatorial middle atmosphere have been studied using temperature measurements obtained from the Sounding of the Atmosphere using the Broadband Emission Radiometry (SABER) instrument on-board Thermosphere-Ionosphere-Mesosphere Energetics and Dynamics (TIMED) satellite during January 2002 to December 2015 (14 years). In the present work, three geographical locations have been chosen, considering 5º x 15º latitude-longitude grid between the altitudes ranging from 20 to 100 km. These locations are named as site 1, site 2 and site 3 and are spread over Equatorial latitudes and ± 120° longitude. A detailed time series and climatology have been established over these regions and significant longitudinal differences has been observed. Characteristics of Semiannual oscillations (SAO), Annual Oscillations (AO) and Quasi Biennial Oscillation (QBO) have been investigated using Lomb Scargle Periodogram and wavelet transform analysis techniques. Form the analysis it is observed that, SAO is showing highest amplitude at 45 km and 75-85 km and QBO is showing significance amplitude in the lower stratosphere. At higher altitudes, amplitudes of all the oscillations (SAO, AO and QBO) are very weak, and temperatures also not revealing any particular pattern. Moreover, from the climatology and time series of the temperature measurements higher temperature (~260 K) has been noticed at 55-65 km height range. In addition to that, seasonal variations over these three regions have been studied and the strength of seasonal difference is found to be about 9 K (summer-winter) at higher altitudes. Furthermore, these satellite-based results are augmented and compared using the MACC (Monitoring Atmospheric Composition and Climate) reanalysis and simulations using a climate model EMAC (ECHAM5/MESSy Atmospheric Chemistry) over the equatorial regions.